Today’s Presenters

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Lack of Reproducibility Damages Science

Reproducibility = Knowledge Transfer = Productive Research
Reproducibility is a Serious Problem

U.S. only NIH funding: ~$40 B/year

60% to 90% not reproducible

Loss: $24-36 B/year

Impact:
➢ For society: delays in development of new medicines and low ROI
➢ For institutions: poor productivity
➢ For scientists: difficult careers

Loss: $24-36 B/year
How do Scientists Deal with Reproducibility in the Lab? It is all about Methods

1. Repeat again and again until it works (at the expense of their institution)
2. Find someone at your institution who can show you how to do the experiment
3. Travel to see original authors who can show you how to do the experiment
Why Showing an Experiment Improves Reproducibility

TEXT ARTICLE

Position the metaphase spindle at 3 o’clock and hold it with holding pipette. Apply piezo pulses to penetrate the zona pellucida. Touch the metaphase plate with the enucleation pipette. Aspirate the spindle and withdraw the pipette.

REAL LIFE

Visualization improves knowledge transfer of how-to (methods)
Reproducibility as a Responsibility

METHODS

DATA PRESERVATION

Librarians

Scientists

Policy Makers

Peer Reviewers

Government

Publishers

Associations

Funding Agencies
Librarians as Agents-of-Change to Solve to the Reproducibility Problem

Educate and drive change from everyone involved

- Educate your faculty, students and management about reproducibility and the solutions available
- Focus on solutions that increase reproducibility from your vendors
- Encourage your faculty to improve their publications to increase reproducibility
What do we mean by “reproducibility”? 
Why librarians?
Why Most Published Research Findings Are False

John P. A. Ioannidis

Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other factors that influence this problem and some corollaries thereof.

Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9–11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the convenient, yet ill-founded strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a $p$-value less than 0.05. Research is not most appropriately represented and summarized by $p$-values, but, unfortunately, there is a widespread notion that medical research articles is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is $R/(R + 1)$. The probability of a study finding a true relationship reflects the power $1 - \beta$ (one minus the Type II error rate). The probability of claiming a relationship when none is true is $\alpha$. For example, if $R = 10$, then when $\alpha = 0.05$ the probability of a false positive is $10/11$.
Lies, Damned Lies, and Medical Science

Much of what medical researchers conclude in their studies is misleading, exaggerated, or flat-out wrong. So why are doctors—to a striking extent—still drawing upon misinformation in their everyday practice? Dr. John Ioannidis has spent his career challenging his peers by exposing their bad science.

Many Psychology Findings Not as Strong as Claimed, Study Says

By BENEDICT CAREY  AUG. 23, 2010

Dutch Cell Culture Contamination Renders Six-decades Worth of Studies False

Science has changed the world. Now it needs to change itself

Is there something wrong with the scientific method?
Amid a Sea of False Findings, the NIH Tries Reform
So Why Us? We’re Good At:

Building Awareness
Education and Instruction
Providing Tools
Advocacy
A vast majority of research workflows look like this:

Idea -> Accio -> Publication!
Workflow and documentation

- Vast majority of the scientific workflow obscured
- Hard to reproduce others work, hard to reproduce our own work
- Difficult to accumulate unpublished knowledge or use published results for additional analyses

In 2 years, will you remember every decision and choice made, how you made it, what tools and instruments you used/modified, and why?
Initiatives and guidance

Enhancing the QUALity and Transparency Of health Research

4 G’s of authorship

No gifts, No guests
No ghosts, No guessing

LEIDEN MANIFESTO FOR RESEARCH METRICS

(TOP) GUIDELINES

Berkeley Initiative for Transparency in the Social Sciences

REWARD: REduce research Waste And Reward Diligence

San Francisco DORA: Declaration on Research Assessment
Some tools for transparency:

- adding alternative evaluation, e.g. with altmetrics
- communicating through social media, e.g. Twitter
- sharing posters & presentations, e.g. at FigShare
- using open licenses, e.g. CC0 or CC-BY
- publishing open access, ‘green’ or ‘gold’
- using open peer review e.g. at Peerage of Science
- sharing preprints, e.g. at arXiv, bioRxiv or OSF
- using actionable formats, e.g. with Jupyter
- open XML-drafting e.g. at Overleaf or Authorea
- sharing protocols & workfl. e.g. at MyExperiment
- sharing notebooks e.g. at OpenNotebookScience
- sharing code e.g. at GitHub with GNU license
- sharing data, e.g. at Zenodo, Dryad, Dataverse
- pre-registering, e.g. at OSF or AsPredicted
- commenting openly, e.g. with Hypothes.is
- using shared reference libraries, e.g. with Zotero
- sharing (grant) proposals, e.g. at RIO

http://tinyurl.com/vienna-openscience
Start with your own actions

Assessing the level of preparedness in ECRs in conducting systematic and scoping reviews: A Scoping Review

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Identifier: DOI 10.17605/OSF.IO/ZDM3C

Category: Project
Description:
A scoping review assessing the level of preparedness of early career researchers conducting systematic and scoping reviews
License: Add a license

Wiki

Project objectives
- to complete a systematic search of the literature to identify studies on ECRs conducting scoping and systematic reviews in the health sciences;
- to identify what is the level of preparedness the challenges and
See the Impact

visits

File downloads

Forks
Barriers and incentives
Adopt, adapt, develop
Being transparent is a choice, we can all start making today
Action plan

Make a commitment to be transparent in your research practices by:

- Registering your protocols/projects/research plan
- Archiving your data in repositories
- Sharing your work via pre-prints/open access venues
- Adopting & contributing to open peer review
- Being transparent about team roles & research contributions
- Encouraging everyone, especially early career researchers, to get informed, and adopt these practices
- Training and advocacy
- Find the champions - better yet, become one!
- Don’t quit
Reproducibility & Transparency are Transdisciplinary
Changing Academia is Hard
Transdisciplinary + Not Afraid of a Challenge = Librarians
How Can We Create Institutional Change?

- Coalition Building
How Can We Create Institutional Change?

- Tools
  - Electronic Lab Notebooks
  - Preprint Servers
  - Data and Artifact Repositories
  - Institutional Versions of OSF, GitHub, etc.
  - More...
How Can We Create Institutional Change?

- Advocacy & Education
Case Study: University of Utah
RESEARCH REPRODUCIBILITY: A YEAR IN REVIEW

381 subscribers  27 lectures  40+ coalition members  2713 video views

Credits: Noun Project (icons), Tisha Mentnech, Donna Baluchi, Peter Strohmeyer, Mellanye Lackey, Heidi Greenberg, Shirley Zhao
Will Change Happen Fast?
Not so much.

Perverse Incentives
Complexity
Not a Problem!
Policies & Laws
Money
Takeaways

● Reproducibility is everyone’s responsibility
● Be Johnny Cash - Walk the line
● BE RELENTLESS
● We are experts
● We can create change. Small actions count.
Resources


Ioannidis JPA (2014) How to Make More Published Research True. PLOS Medicine 11(10): e1001747. [https://doi.org/10.1371/journal.pmed.1001747](https://doi.org/10.1371/journal.pmed.1001747)


Resources

JoVE.com

Reproducibility blog articles: https://www.jove.com/blog/tag/reproducibility

Grand Rounds Research Reproducibility http://campusguides.lib.utah.edu/UtahRR18/GRRR

Reproducibility Resources LibGuide http://campusguides.lib.utah.edu/reproducibility/start

Research Reproducibility 2016 http://campusguides.lib.utah.edu/UtahRR16


Reproducible research practices.
https://mfr.osf.io/render?url=https://osf.io/u4q8m/?action=download%26mode=
Resources

What is OSF? [https://osf.io/7mprv/](https://osf.io/7mprv/)

CRediT ([Contributor Roles Taxonomy](http://docs.casrai.org/CRediT))


Berkeley Initiative for Transparency in the Social Sciences (BITSS): [https://www.bitss.org/](https://www.bitss.org/)


TOP Guidelines: [https://cos.io/our-services/top-guidelines/](https://cos.io/our-services/top-guidelines/)

REWARD Alliance: [http://rewardalliance.net/](http://rewardalliance.net/)

DORA: [https://sfdora.org/](https://sfdora.org/)
Questions?